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EXPANDED PLANNING YARD CONCEPT & CONFIGURATION ACCOUNTING
OR
IMPROVING NAVY SHIP ENGINEERING

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ABSTRACT

For several years the Navy has been methodically improving its organization and procedures for ship engineering. These improvements have resulted in an expanded role for the planning yard. The planning yard's two primary functions are ship alteration engineering and configuration identification. Responsibilities have been clearly defined and more discipline has been incorporated into the process for both of these functions. These improvements are in the early stages of implementation and detailed procedures will continue to evolve.

Requirements for ship acquisition programs have been refined to reflect these improvements.

We have learned that there is a need for clearly assigned responsibility in engineering, that configuration identification must be an integral part of engineering, and that logistics support must be an integral part of engineering.

EXPANDED PLANNING YARD CONCEPT & CONFIGURATION ACCOUNTING

OR

IMPROVING NAVY SHIP ENGINEERING

For several years the Navy has been systematically analyzing problems with our ship engineering and improving the Navy's organization and processes for ship engineering. This paper briefly discusses the Navy organization for ship engineering and some of the major initiatives to improve ship engineering. These initiatives have led to an expanded role for the planning yard in supporting, maintaining, and modernizing Navy ships. The paper focuses on the two primary functions of the planning yard, ship alteration engineering and ship configuration identification.

THE NAVY'S ORGANIZATION FOR SHIP ENGINEERING'

The Navy has a matrix organization for ship engineering; with engineering as one axis of the matrix and management as the other. Engineering activities consist of life-cycle-managers (LCMs), in-service engineering agents (ISEAs), and planning yards. Management activities consist of the Office of the Chief of Naval Operations (OPNAV), ship logistics managers (SLMs), type commanders (TYCOMs), and ship acquisition project managers (SHAPMs). Figure 1 depicts this organization.

OPNAV sets broad policy and priorities for all activities in the Navy,

including ship maintenance, support, and modernization. These priorities are controlled primarily by funding allocations.

Ship logistics managers manage the support and modernization (alteration) of operating ships. Ship logistics managers are assigned responsibilities by ship class and ship type; that is, surface combatants, auxiliary and amphibious ships, submarines, and aircraft carriers. The ship logistics manager is the configuration manager for classes of ships assigned to him; he decides, based on OPNAV direction, what alterations will be installed in his ships.

Type commanders are fleet commands responsible for the maintenance of ships; they also schedule and fund the installation of some ship alterations.

Ship acquisition project managers manage the acquisition of new ships. Each ship acquisition project manager is responsible for the acquisition of assigned' classes of ships. The ship acquisition project manager is responsible for providing the initial logistic support required by the ship when it is first put into operation as well as developing logistic support that is not already in the Navy's standard inventory.

The life-cycle-manager is the headquarters engineer or organization responsible for the engineering and logistic support for a particular system or equipment throughout its life. For his system or equipment, he is responsible for research and development, new ship design and acquisition specifications, in-service engineering, configuration management, logistic support, and budget planning. The

life-cycle-manager provides the engineering for the ship logistics manager and the ship acquisition project manager. In addition, the life-cycle-manager will manage research and development and fleet improvement projects concerning his equipment. The life-cycle-manager is concerned with his system and equipment on all classes of ships in which it is used, while the ship logistics manager and ship acquisition project manager are concerned with only the classes of ships assigned to them.

The life-cycle-manager may be supported by an in-service engineering agent. The in-service engineering agent is a field activity assigned responsibility for day-to-day, hands-on engineering support to the fleet. This engineering support includes ensuring the technical adequacy of logistic support. Some in-service engineering agents also overhaul the equipment for which they are responsible. Most in-service engineering agents also perform the detailed engineering for , and direct the installation of alterations that are within the boundary of a single system or piece of equipment and the system or equipment external interfaces are not affected by the alteration. Examples of such alterations are: Ordnance Alterations (OrdAlts) for combat systems equipment, Field Changes for electronics equipment, and Machinery Alterations (MachAlts) for hull, mechanical, and electrical equipment. (Some Ordnance Alterations go well beyond the foregoing limitations.) These equipment oriented alterations often apply to several classes of ships.

The "planning yard" is actually the design division of a shipyard. There are 13 planning yards; 8 naval shipyards, 4 private shipyards,

and 1 supervisor of shipbuilding. Figure 2 lists planning yard assignments. The planning yard is responsible for engineering done on a class or ship basis. Basically, this involves ship alterations (ShipAlts) which install new equipment, remove equipment, modify systems, modify the ship's arrangements, etc. Planning yards are assigned responsibilities by ship class and generally each planning yard is assigned several classes of ships. The planning yard receives management direction from the ship-logistics manager and technical direction from the life-cycle-manager, In addition to ShipAlt design and engineering, the planning yard is responsible for maintaining selected record documentation (those drawings and manuals essential to the maintenance and operation of the ship and which must be maintained to accurately reflect the ship's configuration). For some classes of ships, the planning yard is also responsible for maintaining the Weapon Systems File, the Navy's single repository of ship component configuration information.

MAJOR INITIATIVES TO IMPROVE SHIP ENGINEERING

Starting in 1976 the Naval Sea Systems Command (NAVSEA) began a critical evaluation of its organization for ship engineering. This evaluation covered, at various times with various studies, military personnel (the Engineering Duty Officer community), civilian personnel (civilian engineers at NAVSEA), and the basic NAVSEA organization. This evaluation resulted in many significant changes in all three of these areas; military personnel, civilian personnel, and the NAVSEA organization. At the heart of all of these changes is the objective of improving our ship engineering; we are still following that course

today.

Starting in 1980, the Navy established Senior Navy Steering Boards to critically examine several ship systems and equipment that were causing serious maintenance and readiness problems in fleet ships. These initiatives, and detailed investigations of the ShipAlt process, pointed out the need to improve the ShipAlt (Fleet Modernization Program) process and our logistic support. Without exception, every equipment that was experiencing serious problems in the fleet had serious logistic support deficiencies.

The basic objective in these initiatives has been to solve not only the specific problem identified in the fleet, but to identify and correct the faults, if any, in the Navy's "system", policy, and procedures for supporting, maintaining, and modernizing ships. In general, this is a complex process involving fundamental changes in several different commands in the Navy. The basic approach has been to analyze the problem, determine a solution, execute a Pilot Project, evaluate the pilot project, make corrections and implement the solution Navy-wide.

Improvements in the Ship Alteration Process

Significant improvements have been made in the ShipAlt process in the last three years. Among these improvements are: clearly assigned responsibility and accountability for ShipAlt engineering, increased technical discipline throughout the process, clear documentation of the process, increased emphasis on logistic support, and increased emphasis on the identification and procurement of ShipAlt installation

material,

The basic ShipAlt process includes three phases of engineering development; ShipAlt Proposal (SAP), ShipAlt Record (SAR), and ShipAlt Installation Drawings (SIDs). Figure 3 illustrates the ShipAlt process. ShipAlts are designed and installed on a ship class basis; that is a single ShipAlt applies to all of the ships of a single class. The ShipAlt Proposal is usually prepared by the headquarters life-cycle-manager, It includes a level of detail typical of a conceptual design and it may identify some early material and logistic support requirements. The ShipAlt Proposal is the basis upon which the ship logistics manager's change control board decides whether or not to approve the alteration.

Once the ShipAlt Proposal is approved, the ship logistics manager tasks the planning yard to prepare the ShipAlt Record. The ShipAlt Record increases the level of detail of the ShipAlt Proposal and verifies the ShipAlt Proposal. The ShipAlt Record is important in that it identifies long-lead material for the ShipAlt installation and it identifies the logistic support required for the ShipAlt. Without a good ShipAlt Record, the early installations of the ShipAlt may have material problems and may not be properly supported. The ShipAlt Record is approved by the ship logistics manager and by the life-cycle-manager,

The ship logistics manager tasks the planning yard to prepare the ShipAlt Installation Drawings. The ShipAlt Record must be approved before drawings can be issued. The planning yard performs all of the necessary shipchecks and design work to produce a unique set of

ShipAlt Installation Drawings tailored to each individual ship of the class. To allow sufficient time for production planning, the ShipAlt drawings should be delivered to the installing shipyard twelve months before the start of the ship availability. Although every planning yard is not yet consistently delivering drawings twelve months before the start of the availability, every planning yard is steadily progressing towards this goal.

During the ship availability the planning yard provides an on-site representative to assist the installing activity with any technical problems that arise with the ShipAlt package. The planning yard is responsible for incorporating lessons learned into the design for future installations of the ShipAlt.

The ship logistics manager is responsible for ensuring that all of the installation material and logistic support is provided for the ShipAlt. Of course, the ship logistics manager depends on the planning yard and the life-cycle-manager to identify the installation material and the logistic support required.

Perhaps the most significant improvement in the ShipAlt process is the clear assignment of technical responsibility to the planning yard. In the past, the planning yard was only responsible for the "Basic Alteration Class Drawing" (BACD), the drawings for the first installation of the ShipAlt. The installing activity was responsible for shipchecking the ship and tailoring the alteration drawings to that specific ship by preparing "Supplementary Alteration Drawings" (SADs). With such split responsibility there was little accountability for the ShipAlt engineering. Today, the planning yard

is totally responsible for ShipAlt engineering, even during the installation of the alteration. To date, all planning yards readily accept this responsibility, although some installing shipyards are reluctant to depend on the planning yard for all of their ShipAlt design work. For practical reasons, the installing yard typically resolves minor technical problems, and the planning yard's on-site representative works through the installing yard's design organization in correcting any major technical problems. There have already been some instances of the planning yard sending a team of engineers to the installing shipyard to correct problems with a ShipAlt design. This process will foster the incorporation of lessons learned into the design of subsequent ShipAlt packages and will help improve the quality of ShipAlt engineering. (Note: For a few older- classes of ships only Basic Alteration Class Drawings are prepared by the planning yard and Supplementary Alteration Drawings are still prepared by the installing activity. Nevertheless all of the other improvements in the ShipAlt process apply to these older classes of ships.)

Today there is considerably more discipline in the ShipAlt process than there was three years ago. There are technical specifications for ShipAlt Proposals, ShipAlt Records, and ShipAlt Installation Drawings (including Basic Alteration Class Drawings and Supplementary Alteration Drawings); there were no such specifications in the past. Technical problems and decisions are documented using "Liason Action Records" (LARs); there was no such documentation required in the past, Each step in the process, ShipAlt Proposal, ShipAlt Record, ShipAlt Installation Drawing, and the installation of the ShipAlt, is

clearly defined with specific milestones and minimum requirements established. Headquarters life-cycle-manager approval is required for every alteration; no life-cycle-manager involvement was required in the past. The life-cycle-manager may direct that he approve some or all of the ShipAlt Installation Drawings for complex alterations. Complex alterations require formal proofing of the installation and the design. And, last, the entire process has been clearly documented in the new Fleet Modernization Program (FMP) Manual.

For most ShipAlts today, the ship or a fleet activity supporting the ship must order some or all of the logistic support required for the alteration. In such cases it is not unusual for the support to arrive several months after the ship has been operating with the alteration installed. Due to the evidence of serious logistic support problems in the fleet, considerable emphasis is placed on logistic support in the ShipAlt process. The basic objective is to provide the logistic support to the ship concurrent with the installation of the alteration. The planning yard and the life-cycle-manager identify the requirements for new logistic support for the alteration and the ship logistics manager initiates and manages the actions necessary to deliver the logistic support. A variety of activities, including the life-cycle-manager, are responsible for actually providing the support. The Fleet Modernization Program Manual defines the who, what, when, and where for logistic support. Each activity responsible for procuring logistic support must certify the availability of the support and document deficiencies. The major emphasis today is on spare parts, preventive maintenance, technical documentation (drawings and technical manuals), and crew training. The process for providing

logistic support for alterations is still being refined.

The last major initiative in improving the ShipAlt process is the identification and procurement of alteration installation material. As with logistic support, the planning yard and the life-cycle-manager are responsible for identifying the material and the ship logistics manager is responsible for initiating action and managing the procurement of the material. The life-cycle-manager may identify and play an active role in the procurement of some special items. Plans to improve the material aspects of the ShipAlt process are still evolving.

Today most classes of ships have been included in the improved ShipAlt ("expanded planning yard") process described above for about two years. All new ships will be included in this process. Every planning yard has accepted these responsibilities and is steadily moving towards the goals set by the improved process. The ship logistics managers are working towards managing the ShipAlt process to meet these goals. Life-cycle-managers review and approve every ShipAlt Proposal and ShipAlt Record. And, OPNAV has provided the funding to do a better job of engineering ShipAlts,

NAVSEA headquarters closely monitors each yard's performance and the working of the ShipAlt process. Formal audits are conducted on selected ShipAlts and regular status meetings are held both at headquarters and with the planning yards. Follow-up action is taken to correct problems at a particular planning yard and to correct systemic problems with the new ShipAlt process.

Improvements in Ship Configuration Identification

One of the root causes of logistic support problems is the lack of complete, accurate configuration information for Navy ships and ship systems. Configuration information is the description of what systems, equipment, components, etc. are on the ship. A configuration item is any item:

- 1, that requires any type of logistic support, or
2. for which configuration data is needed to operate, maintain, or support the ship.

A configuration item may be at any level from the ship itself down through the piece-part level if necessary. Even a squadron or group of ships may be considered a configuration item. A configuration item may be included just for the purpose of completely defining the configuration of the ship or a system.

Configuration information is needed by logistic support activities that provide logistic support to the ship; they must know what they are supporting. Maintenance activities, such as tenders and shipyards, need configuration information to plan and execute maintenance. The personnel system needs configuration information to determine the number of crew, and their required qualifications, to man the ship. Life-cycle-managers and in-service engineering activities need configuration information so that they know where their equipment is installed and the characteristics and alteration status of each installation. Planning yards and in-service engineering agents need configuration information to design and

engineer alterations.

The "Weapon Systems File" is a central computer data base of ship configuration information. For 15 years it has been the Navy's single, authoritative source of information for ship configuration. Unfortunately, the Navy's engineering community neglected the Weapon Systems File and the Weapon Systems File structure did not satisfy the needs of many users. For example, it was very difficult to enter a configuration item in the file if the item did not have identified supply support, yet there are many items that require maintenance that do not have identified supply support. Configuration information is in Selected Record Drawings and other technical documentation; there was no attempt to reconcile the Weapon Systems File with the drawings and documentation.

There were two other fundamental problems with the Navy's system for ship configuration identification. First, there was no clearly assigned responsibility and accountability. Many activities could add, change, or delete data in the Weapon Systems File with no one having overall responsibility for the File for a ship. Several activities were responsible for processing data, no one was responsible for the accuracy and completeness of the File at all times. Second, the configuration status accounting functions were independent of the rest of the configuration management functions. The Ship Equipment Configuration Accounting System (SECAS), which maintained the Weapon Systems File, was independent of the ship logistics manager's configuration control and the planning yard's and in-service engineering agent's alteration engineering.

Due to the recognition that many of our “technical” problems are actually caused, or exacerbated, by inadequate logistic support, and the recognition that adequate logistic support and cost effective maintenance depends on good configuration information, the Navy’s engineering community has finally taken a sincere interest in ship configuration. The results of this interest are the development and implementation of the “Ships Configuration and Logistics Support Control Process”, the redesign of the Weapon Systems File, and improvements in Selected Record Drawings. The objectives of the Ship Configuration and Logistics Support Control Process are:

- a. establish and maintain, with a high level of confidence, accurate configuration and associated technical and logistic support information for critical systems in ships, and
- b. define and implement the system, procedures, and responsibilities to accomplish this objective.

The actions necessary to meet the foregoing objectives and solve the problems mentioned above are:

- 1. Clearly assign responsibility and accountability for the accuracy and completeness of information in the Weapon Systems File to a single engineering activity.
- 2. Structure the Weapon Systems File based on the functional configuration of the ship.
- 3. Correlate logistic support information with the configuration information in the Weapon Systems File.

4. Define procedures and assign responsibilities for reporting changes in a ship's configuration or logistics support.

5. Define responsibilities for correcting discrepancies in a ship's configuration and deficiencies in a ship's logistics support,

Each of these actions is discussed further in the following paragraphs.

It was decided to assign responsibility for the information in the Weapon Systems File based on technical responsibility for the equipment aboard the ship. That is, the activity responsible for the engineering for the equipment would be responsible for the configuration information for their equipment. Since the planning yard has overall responsibility for the engineering for a class of ships, the planning yard is assigned overall responsibility for the Weapon System File for assigned classes of ships. The in-service engineering agents provide configuration and logistic support information to the planning yard in establishing the File for a ship and in maintaining the File as the ship's configuration or logistics support is changed. The planning yard is responsible for hull, mechanical, and electrical equipment configuration information and for the overall File. In addition, any activity that installs an alteration, or changes a ship's configuration during repairs, is responsible for reporting the 'change to the planning yard. Only the planning yard is authorized to change information in the Weapon Systems File.

Assigning the responsibility for configuration information to these engineering organizations enhances the integration of configuration accounting with the rest of the configuration management functions. The planning yard is responsible for the engineering for significant configuration changes, i.e. ShipAlts, and monitors their installation. The in-service engineering agents generally perform the engineering for specific equipment configuration changes, i.e. Ordnance Alterations, Field Changes, and Machinery Alterations, and directs their installation. Installing activities actually make the change. Including configuration identification responsibilities with engineering responsibilities will lead to improved configuration information with reduced cost. For example , rather than sending an independent team to shipcheck the ship's configuration, the engineering activity can combine alteration design shipchecks with configuration shipchecks done by technician and engineers that know the system they are checking.

A very important concept is the functional structure of information in the Weapon Systems File. A good, functional hierarchical structure is fundamental to presenting useful information. The old Weapon Systems File was not rigorously structured based on the design of the ship systems. For example, the components that made up the "firemain" in the Weapon Systems File might not be at all related to the components included in the "firemain" in drawings, technical manuals, and other documentation aboard the ship. As a result, it was often very difficult to find an item in the File and to be sure that the correct item was identified. In addition, it was very difficult to see that

there is a one-to-one correlation between the actual shipboard systems and the File. This problem was amplified by the use of only "commodity nomenclature", such as, "valve, globe, 4 inch, 600 psi" in the File.

The functional hierarchy is represented by two pieces of information, the "equipment functional description" and the "functional group code". The equipment functional description is the English language name typically used by operating and maintenance personnel; for example, "fuel oil service pump no. 1", or "air conditioning plant no. 3 motor controller". The functional group code is a number assigned to each item so that a computer. (or a person) can identify the system-subsystem-equipment-component relationships and present the information to the user accordingly. There is a one-to-one correspondence between the equipment functional description and the -functional group code. Every configuration item is assigned a unique equipment functional description and a corresponding unique functional group code.

The Navy ship design community has used a standard functional hierarchy called "Ship Work Breakdown Structure (SWBS)" for many years. This structure is well known to all Navy ship designers: Group 100 is hull structures, Group 200 is propulsion, Group 300 is electrical power generation and distribution, etc. This long-standing system has recently been extended to lower levels of indenture to fully meet the needs of configuration identification. This "Expanded Ship Work Breakdown Structure/Functional Group Code" has been promulgated in the new NAVSEA instruction 4790.1A, "Expanded Ship Work

Breakdown Structure (ESWBS) for All Ships/Ship Systems”, The instruction defines the procedures and requirements to develop a logical configuration definition of the ship starting with the design of the ship, defined in detail during the construction of the ship, and maintained during the life of the ship. This functional identification is tremendously important because it is the single link that ties the ship’s functional configuration (the ship itself), which is what the operator and maintainer recognizes, to the logistics support and technical information for that configuration.

Most of us recognize “ILS” as “Integrated Logistics Support”. Unfortunately, today’s Navy logistic support elements are more “Independent” than “Integrated”. The shipboard sailor or shipyard worker has no single source he can depend on to identify all of the support for an item. (Without the foregoing functional structure for information, he may not be able to identify any of the support for an item!) Another major element of the Ship’s Configuration and Logistics Support Control Process is identifying all of the major logistic support required for each item and correlating that with the configuration information. Today we are focusing on just spare parts, technical manuals, drawings, preventive maintenance, test equipment, and eventually training. However, we are building the capability to identify virtually any piece of technical or logistic support information to the configuration. This provides the user, the operator or maintainer, with the necessary logistic support information in one document, or computer file. This information is stored in a central file, accessible to all users, so that once the research is done to identify the technical and logistics information

it is not necessary for other users to repeat the same research. Note, that the object is to just identify the logistic support. That is, the drawing number or technical manual number would be identified; the File would not actually contain the drawing or technical manual itself,

Establishing a properly structured, accurate File is only part of the process. Equally important are the procedures and responsibilities for establishing and maintaining the information in the File. These two pieces of the overall process must be designed to work together; the central computer file and processing (the Weapon Systems File) must be compatible with the management system for maintaining the data in the file. The best automatic data processing system we can design cannot make up for an inadequate management system for establishing and maintaining that data. The Navy has defined this process in directives for the Ship's Configuration and Logistics Support Control Process. In the near-term we are making the necessary changes to the Weapon Systems File computer programs to accomodate the Ship's Configuration and Logistics Support Control Process. For the long-term we are completely redesigning the Weapon Systems File computer software so that it is fully compatible with the new concepts and process for maintaining ship configuration and logistic support information.

The final significant feature of the Ship's Configuration and Logistics Support Control Process is correcting the problems discovered during the process. When the planning yard discovers either a configuration discrepancy or a logistic support deficiency (logistic support not

available in the Navy system), he informs the ship logistics manager who initiates action to correct the deficiency.

Ship configuration information is also represented in "Selected Record Drawings". Selected Record Drawings are typically systems drawings and ship arrangement drawings that are essential to the modernization, maintenance, and operation of the ship. Selected Record Drawings are maintained current throughout the life of the ship. Improvements have also been made in the Selected Record Drawing process. In the past, planning yards had custody of the drawings, overhaul shipyards were responsible for updating the drawings to reflect alterations installed by the shipyard, and the ship's crew was responsible for marking up the drawings to reflect changes or corrections between overhauls. This split responsibility resulted in inaccurate Selected Record Drawings. In addition, very few ship systems had been designated for Selected Record Drawing coverage on surface ships. These problems are now being corrected by expanding the list of Selected Record Drawings for surface ships to cover all critical ship systems and by clearly assigning responsibility for the Drawings to the planning yard. (Submarines already had a comprehensive list of Selected Record Drawings).

These initiatives to improve ship configuration identification are still in the early stages of implementation. The pilot project for the Ship Configuration and Logistics Support Control Process is the FFG 7 Class with Long Beach Naval Shipyard as the planning yard. Restructuring the Weapon Systems File to reflect a true functional hierarchy, identifying all of the key logistic support, and

correlating the logistic support to the configuration has turned out to be a formidable task. This effort will be completed this-fall on the first FFG 7 Class ship. It includes updating the Selected Record Drawings, and ensuring that the Drawings are consistent with the Weapon' Systems File.

The Ships Configuration and Logistics Support Control Process has been documented in a draft technical specification and several other planning yards have been tasked to begin implementing the Process on selected classes of ships. New classes of ships will follow the new Process when those ships are commissioned. In the meantime, most existing classes of ships are still under the Ship Equipment Configuration Accounting System (the system and procedures used to maintain the Weapon Systems File before these improvements) using the old Weapon Systems File structure.

OPNAV has budgeted and allocated the funds for the planning yards to prepare the additional, new Selected Record Drawings for many classes of ships over the next several years. This effort just started in 1985.

Last, the redesign of the Weapon Systems File for the long-term has just begun. The Navy's engineering, maintenance, and logistics. support communities are working together to prepare a requirements statement for the development of new computer software.

Improvements in New Ship Acquisition

We are learning the hard way how difficult it is to correct serious

deficiencies in configuration and logistic support identification and in the actual logistic support for ships that have been in service for several years. As a result the Navy is incorporating the lessons learned from these efforts into new ship acquisition requirements, Past shipbuilding programs were not required to deliver a good, functionally structured configuration and logistic support data base. Some ship acquisition programs did prepare such a data base in the past. However, the Navy had no way to store, maintain, and disseminate the information in such a data base. Future shipbuilding programs will be required to provide a validated data base of configuration and logistic support information in the format required by operational ships. That data base will establish the new Weapon Systems File for the ship.

In addition, we are defining the planning yard's role and adding more discipline to the life-cycle-manager's role in new ship acquisition. Life-cycle-managers are placing more emphasis on new designs, major new designs are being done primarily "in-house" by collocated design teams which include design contractor and potential shipbuilder support. And, life-cycle-managers are taking a more rigorous approach to identifying requirements for the review and approval of the shipbuilder's drawings and other products. The result is more detailed life-cycle-manager review of more shipbuilder products.

In the past, the planning yard did not participate in the ship acquisition and may not have been designated until after the ship was delivered. The planning yard is now designated during the ship design phase. The planning yard participates in the Contract Design and in

the ship acquisition process. The planning yard's involvement is primarily in configuration identification and in the documentation, such as Selected Record Drawings, needed to maintain and modernize the ship.

This emphasis on new construction requirements is important because these products are essential to effectively maintaining, supporting, and modernizing ships at a minimum cost. By providing a clearly defined, user oriented index of all necessary information, exercising the discipline described here for configuration and logistic support identification may actually lead to reductions in shipbuilding costs as well.

SUMMARY

The important lessons learned from these experiences are:

The need for clearly assigned responsibility and accountability in engineering;

The need for including configuration identification as an integral part of engineering.

The need for including logistic support as an integral part of engineering.

In an organization as large as the U.S. Navy it is easy to diversify responsibilities to the point that no one is really responsible for the end product. Unfortunately, this happened to our ship engineering. The Navy is now well along the course for correcting

this problem. Responsibilities have been clearly defined and accountability clearly assigned for much of our ship engineering. The engineering process for ShipAlts has been defined so that the responsible organizations have the authority and are in a position to exercise their responsibility. This concept is much more than just being able to identify who caused a problem. The most important benefit of clearly assigned responsibility and accountability is the sense of ownership and pride in the product that is nurtured in the individual engineer and in his organization. We are seeing this today in our planning yards. For the first time in years the planning yard engineers that work on a ShipAlt design can say, "This is my design," They are taking pride in their work and showing a sincere interest in doing a good job of engineering) following up on the installation, and improving their design. The planning yards are developing a real sense of ownership for their classes of ships and are rapidly becoming the Navy's experts for their ships, No management or quality assurance system can do as much to assure a quality engineering product as this sense of ownership.

The need for good configuration information to support, maintain, and modernize our ships is obvious. Each of these areas suffers with poor performance and unnecessary expense due to the lack of good configuration information. To be useful to the wide variety of activities that need configuration information, and to maintain a good quality match between the configuration information and the actual ship, the configuration information must be functionally structured. In addition, all of the configuration information) such as drawings, systems manuals, training manuals, and the Weapon Systems File, must

be consistent. The engineer responsible for the design and maintenance of a system or equipment must define its configuration, That engineer fully understands his system; no one else can define its configuration as well as he can. This configuration definition must start with the system design and be maintained, as part of the engineering process, throughout the life of the system. Once defined, that configuration then drives the entire logistic support, maintenance, and modernization process; it should drive the new construction process as well. Rigorously defining the configuration, in functional terms that all users clearly understand, provides the link between the ship itself and all of the technical and logistics support information for the ship. By providing a clearly defined, user oriented index to all of the information needed, exercising this process can lead to significant savings in ship construction as well as ship maintenance, support, and modernization.

Our configuration problems also reinforced the lesson on responsibilities. Without clearly defined responsibilities and a disciplined process for maintaining configuration information, extensive computer verifications and independent audits, etc. failed to maintain a complete, accurate, useful configuration file.

Perhaps the solution that is the most difficult to implement is making logistic support an integral part of engineering. The Navy has a very complex system for providing logistic support to ships. As a result, the sailor is left with a very complex job to find all of the support he needs to operate and maintain his equipment. Each logistics support element (technical manuals, supply supports training, preventive

maintenance, etc.) is provided by separate organizations that function independently of one another. The only place that these elements are brought together (besides at the user at the end of the chain) is at the engineer at the beginning of the chain. The engineer must identify the need for logistic support; he must see that each element of logistic support is technically correct; and he must see that the various elements of logistic support are compatible (for example, that the supply system provides the parts needed for the preventive maintenance and that the technical manual explains how to do that preventive maintenance). No one else has the thorough understanding of the equipment necessary to correctly structure the logistic support. Without the engineer's involvement, all of the paper analyses and quality assurance plans are doomed to producing a less than adequate end product.

In most of our engineering organizations today, logistic support is not even an integral part of the organization or of the engineer's responsibilities. The logistic support is often left up to a separate "allowance" section or to logisticians that perform all of the technical work associated with the logistic support. Our organizations must change so that the technical work necessary for good logistic support is a clearly defined engineering responsibility. We will always need specialists in each logistics support area. However, these specialists must be a small group that works closely with, and relies upon, the designers to produce a good logistic support package. We are beginning to see this happen in some of our planning yards today and in some of our life-cycle-management organizations.

The Navy's efforts to improve ship engineering are **just beginning**, After years of correcting organizational and personnel problems and analyzing procedural and systemic problems, we are at the beginning stages of defining, evaluating) and implementing the fundamental changes to the Navy's system that are necessary to improve our ship engineering. Making such substantial, fundamental changes to such a large, complex organization must be approached with care and takes time. The planning yard is a key organization in the Navy's ship engineering process and the focal point of many of these improvements. We are finally at the point where we can begin to see some results from these systemic improvements. NAVSEA will continue to closely evaluate our performance in ship engineering, including configuration management and logistic support, and make needed improvements in our organizations, systems, and procedures. These improvements in ship engineering undoubtedly will result in much needed improvements in fleet maintenance, support, and modernization. We still have a long way to go.

FIGURE 1
THE NAVY'S ORGANIZATION FOR SHIP ENGINEERING

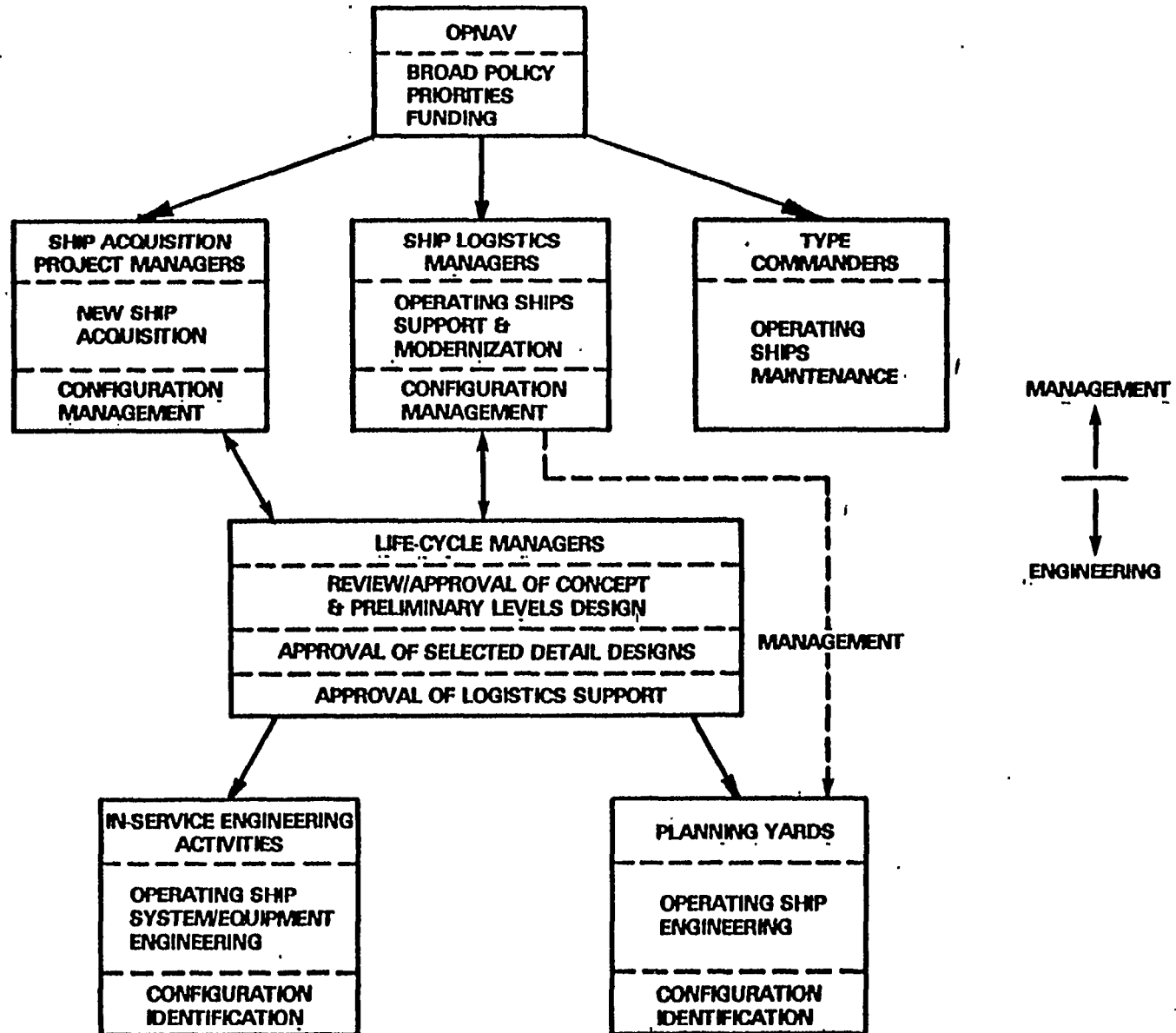
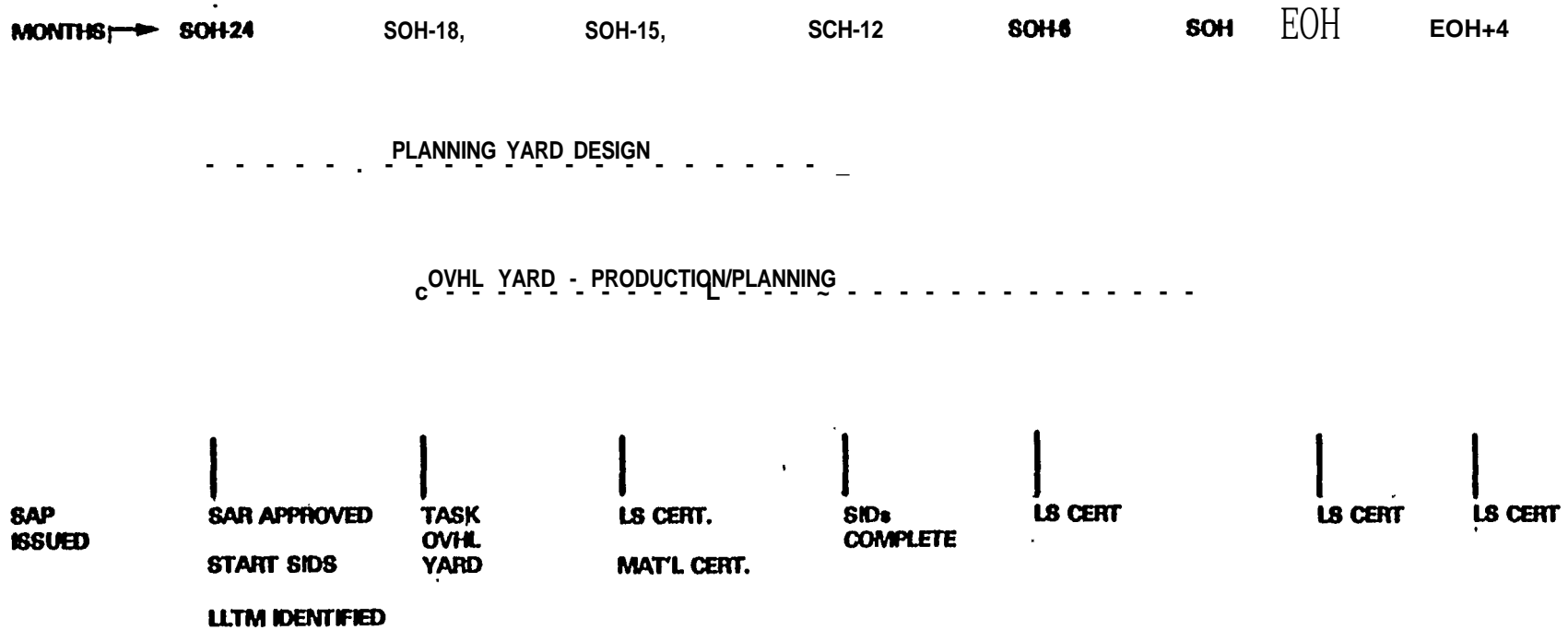


FIGURE 2

PLANNING YARD ASSIGNMENTS

o NAVSHIPYARD PORTSMOUTH	SSN 594; SSN 637
o NAVSHIPYARD PHILADELPHIA	LCC, LPN, DDG 2
o NAVSHIPYARD NORFOLK	CGN, CVN 68 (LANTFLT), DDG '51
o NAVSHIPYARD CHARLESTON	AD, AS, AR, MSO, MSH, DRYDOCKS
o NAVSHIPYARD PUGET SOUND	CVN 65, CG, CV, (PACFLT), UNREP SHIPS
o NAVSHIPYARD MARE ISLAND	ASR 21, DSV, DSRV
o NAVSHIPYARD LONG BEACH	BB, LHA, FF1037, FF1040, FFG 1, FFG 7
o NAVSHIPYARD PEARL HARBOR	FF 1052, ARS
o SUPSHIP BOSTON	LKA, LPD, LSD, LST
o ELECTRIC BOAT	SSBN'S + UNIQUE SSN'S
o NEWPORT NEWS	SSN 688
o INGALLS	DD 963, DDG 993, CG 47
o BOEING MARINE	PHM

FIGURE 3
SHIPALT PROCESS



SOH-START OF OVERHAUL
EOH- END OF OVERHAUL
SAP - SHIPALT PROPOSAL
SAR - SHIPALT RECORD
SIDS - SHIPALT INSTALLATION DRAWINGS
LLTM - LONG-LEAD-TIME MATERIAL
OVHL- OVERHAUL
18 CERT - LOGISTICS SUPPORT CERTIFICATION OF AVAILABILITY
MAT'L CERT - MATERIAL: CERTIFICATION OF AVAILABILITY

LIST OF FIGURES

FIGURE 1 THE NAVY'S ORGANIZATION FOR SHIP ENGINEERING

FIGURE 2 PLANNING YARD ASSIGNMENTS

FIGURE 3 SHIPALT PROCESS

Comment by L.D. Chirillo

Re "Expanded Planning Yard Concept & Configuration Accounting"
by CAPT A.R. Karn & CDR E. Runnerstrom
NSRP 1985 Ship Production Symposium
12 September 1985

As a result of a series of NSRP projects, all major private shipyards in the U.S. are now adopting zone-oriented logic for constructing ships. The same logic has been successfully applied by the Puget Sound Naval Shipyard for ShipAlts and also for overhaul work. A pertinent paper is being presented during this Symposium.

As a consequence, some private shipyards have already started to abandon traditional functional organizations in favor of product organizations. In principal, their organizations will be similar to those employed by successful corporations such as Exxon and IBM. The singular feature of product organizations, is their unprecedented integration of design engineering and production engineering.

We have heard that because of the Expanded Planning Yard concept, at least one Navy yard will have to apply about 90% of its total design effort for projects to be undertaken in other yards. This seems to be at odds with the greater integration of design engineering and production engineering that many corporations, including CM, are now finding necessary for survival. In this respect, the Expanded Plan Yard concept seems to be a movement in the exact opposite direction from where research into modern organizational theory is leading us.

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